Selection of Cognitive and Aesthetic Features in Digital Contents for The Elderly Users

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ABSTRACT

Information and Communication Technologies (ICTs) continues to be a major driver of economic and social modernization. The developed online applications such as websites, e-books, social media, e-news updates, e-shopping platforms and weather updates applications have become daily main routines to the elderly group. Nevertheless, most of these online applications do not promote comfortable text reading to this group. This has led to difficulty of interactivity between the elderly and online applications. The frustrating emotions in reading experience, unsuitable typeface presentation and poor aesthetic elements in digital contents have led to study aims; to determine suitable cognitive and aesthetic features presented in digital contents for the elderly. Study focuses on Malaysian elderly aged 60 and above who literally aware of internet surfing, having healthy physical body but suffering low vision problem. Mixed methodology approach is adopted for this study. Literature study produces qualitative results while quantitative output are from think aloud observational method, questionnaires distributions and interview sessions. All participants participated in three experiment contexts. Study analysis includes listing suitable independent variables which are cognitive and aesthetic features; to produce users' satisfaction and increase performance during reading digital contents. Experimental data are processed to obtain suitable typeface features by undergoing two phases which are initial phase: problem analysis and feasibility study and in second phase: data analysis on cognitive and aesthetic features identification. Study results are recorded and compared through the time taken by the elderly to complete and grasp text meaning. As participants demographic varies, they prefer contents' language that comes in Malay or English. Cognitive scores showed language as less important but participants prefer a clear and simple text display. Whilst for aeshetic elements, participants achieve their usability experience if there are contrast in font color, bigger font size, having background contrast as well as larger space between lines and margins. These features must be considered by the content designers so that it satisfies users' performance and users' satisfactions when reading online contents.

INTRODUCTION

Information and Communication Technologies (ICTs) continues to be a major driver of economic and social modernization. Year 2017 which is in the era of free Covid pandemic, Europe devoted 34 percent of its investments to ICTs [1] while Malaysia dedicated 17 percent of investments in ICT sector [2]. The developed online applications such ase-books, social medias, banking transactions, video conferencing, e-shopping platforms and weather updates applications have become daily main routines to the community including the baby boomers and elderly group. Nevertheless, most of these online applications do not promote comfortable text reading based on group preferences especially to the elderly group. This has led to difficulty of interactivity between the elderly and online applications [3]. The elderly group whom age ranged 60 years and above, is becoming more and more internet savvyand they do maintain strong online presence. It was reported in 2020 by Malaysian Communications and Multimedia Commission (MCMC) on internet usage and active online activities that 3.4 percent are amongst the elderly

[3,4]. Disappointedly, most of internet activities do not cover the needs and satisfaction of senior citizens.

Problems encountered are difficulty to engage with daily reading related activities, frustrating reading experience due to digital content presentation, unsuitable typeface presentation in digital contents and poor aesthetic digital contents interface. It was reported that 60 percent of elderly patients suffer low vision [5] that includes impairment of visual functioning even after treatment [6]. Besides that, aesthetic features promoted in websites always become first impression either user will stay or move to the next webpage [7]. Tiny strings of letter with space can be attractive design elements, but if they cannot be read by the elderly group, it will be useless. Instead, the designer must create beauty plus readability [8]. As their vision and focus deteriorates biologically, they always face the problems of readable type size, legible typeface choice and reasonable line lengths [9]. This frustrating reading experience signifies that the digital contents prepared by some designers have ignored on applying usability study and there are no proper guidelines for digital content designs and developments. Selecting the appropriate typeface to express and communicate a message is crucial, yet neglected by most digital content designers. Determining suitable typeface features include letter contrasts, non-glare finish, simple letterforms, width and height of font ratio as well as character stroke [10] are the elements to highlight. Based on these problems, it can be concluded that the elderly finds it difficult to read e-text as the typeface features presented do not support their sensorial, cognitive and aesthetic preferences in digital contents. This has led to study aims, which are identifying suitable cognitive and aesthetic features in digital contents based on usability studies.

LITERATURE STUDIES

Based on the World Health Organization, the definition of low vision is the loss of visual acuity less than 6/18 down to and including 3/60[11] in the better eye from all causes. There are three characteristic that a person with low vision [12] which are impairment of visual functioning even after treatment and standard refractive correction. In other words, low vision is often defined as visual impairment that interferes with a person's ability to perform everyday activities. There are five categories of visual impairment that impact web use, excluding total blindness. These are visual clarity, light sensitivity, contrast sensitivity, field of vision and color vision [13,14]. There is still hope for a better life for a people with low vision using low vision devices such as magnifiers to help them make the best use of whatever vision is available to them. The causes of low vision in older people vary according to region [15]. Indeed, it is estimated that 80 percent or 48 million [16] of low vision people in the world are aged over 50 and need digital assistance during digital content usage. Assistance are referring to spectacles, turning the device horizontally or vertically to get conformable reading angle, and setting features to reset the contrast, brightness and font size [17]. Customization of the presentation of reading materials for low vision is vital. This low vision group needs to change the setting of text size, font type, background color, text color and line spacing. Background color should be changed in high contrast or low contrast of the text is depending on the need and vision problem face by the users [18]; without being able to change the presentation of the content, low vision group always face eyestrain, headaches or nausea. Thus, good typography is the solution. Typography is the art of laying out text for print or on screens for aesthetics and for readability. It concerns the use of different font faces and sizes and layout constraints such as line height, column width, kerning, and color contrasts. There are many guidelines being introduced to improve text presentation in online applications. Each of these sets of guidelines claims that using their guidelines will improve web accessibility and usability for older people. For example, SPRY Foundation guidelines [17,19], Holt guidelines [20], Agelight guidelines [21] and National Institute of Ageing guidelines [10,19,22]. The guidelines given do not optimize the needs especially from elderly group whom are overall contributing 53 percent [23] of online e-text readers with an average of 27 hours per week of surfing. Thus, a special support is needed to support them in carrying out their activities

and works. The elderly population is increasing but there is still lack of modification to the technological gadgets and have tendency of those rejecting gadgets which makes this elderly group have limited selections to use [18,24]. The problems occur amongst the elderly when they need to interact with digital content, but being served by the designers with digital presentation that do not consider on aesthetic, sensorial and cognitive elements of its readers or viewers [25]. Yes, there are various assistive tools in the market, for such hand held illuminated [26], computer connectable digital camera, desktop electronic magnifier. Nevertheless, applications held in appstore like Spotlight Text Application (for iPAD users) enable user toenlarge the text size, auto scroll function, equip with flexible speed control [27], have up and down buttons [16,28]. It is good for a lot of people, but some people may prefer a different color contrast for interesting presentation and reading experience. At present, the number of Malaysians aged 60 years and above is estimated to be 1.4 million and is projected to increase to 3.3 million in the year 2020 [29,30]. It was reported by United Nations, that these senior populations globally had reached 962 million in year 2017, comprising 13 percent of the global population and increasing to 21 percent by 2050 [31]. The change in population demographics is also leading to an increase in the number of electronic text (e-text) readers. Nonetheless, the elderly online users face numerous barriers when reading e-text because of age related physical as well as declining of sensory, cognitive and aesthetic capabilities. Lots of researchers had their discussion on presenting good typography [32], but less discussing on typeface alone. Nevertheless, none had studied on how to help the elderly to overcome their problem in e-text reading because of improper typeface presentation in digital contents.

METHODS

Mixed methodology approach is adopted for this study. Literature study produces qualitative results while quantitative output are from think aloud observational method, questionnaires distributions and interview sessions. Methods used list suitable independent variables which are cognitive and aesthetic features; to produce users' satisfaction and increase performance during reading e-text. Experimental data are later processed to obtain suitable typeface to be used in digital contents. Two phases are planned for this study to achieve the research aim.

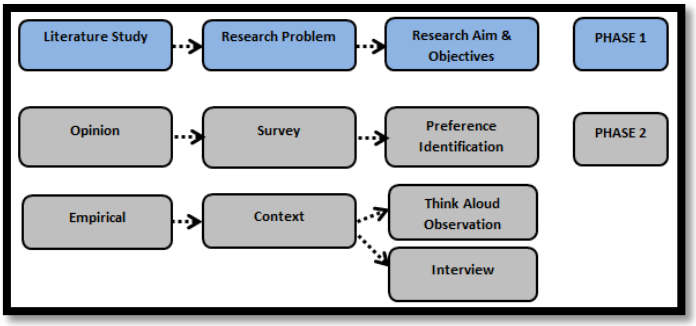

Figure 1. Methodology Used for This Study.

The first phase requires finding related study, information concept, identification of suitable cognitive features and aesthetic preferences by the elderly readers. Later, research aims and objectives aredefined based on literature studies. Issues studied are on visual impairments including the impairments' types, favorite digital contents that they serve daily, time consumption to complete reading and grasp the contents' meaning (in a given text context) and elderly's expectation for aesthetic content features. Next, in second phasefocus are on experiments, data analysis and typeface features' identification. Experiments were done using small display device size by applying think aloud observational method, as well as parellalinterview activities.

Participants

Study focuses on Malaysian elderly who aged 60 and above, having a healthy physical body but suffering low vision problem. Twenty participants participated in these experiments. They were selected randomly, 16 of them are government pensioners from various sectors and the remainings are still running small businesses around Ipoh city. Demographically, regardless of their gender, these elderly are literally aware of internet surfing and deal daily with digital contents, tools and technologies.These elderly are amongst digital content readers who perform high cognitive load yet expecting pleasant aesthetic presentation of typeface in digital contents. The activities include e-text reading, socializing in social media, performing e-banking, reading medical status and involving in e-commerce. Besides, is also aim of this study.

EXPERIMENTAL

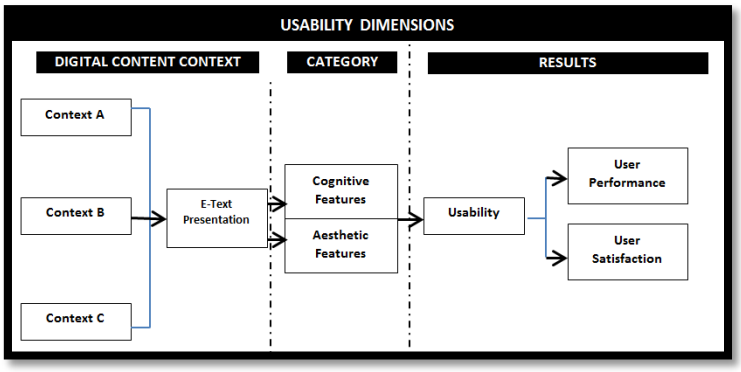

Figure 2. Usability Dimension for This Study.

Participants participated in three contexts. Selection of contexts were based on most viewed online contents. In Context A, all participants were presented with the webpages on online banking. In Context B, participants were tested on application installed and social media contents. As for Context C, participants' responses were recorded when viewing on e-news webpages. Each context responses were recorded separately and gap time of 5 minutes were given for each context transition. Whilst the think aloud session, interviews were done paralelly during the experiment. The experiment planwere recorded as in Table 1.

Table 1 Think Aloud Experiment Sessions

Context	Content Category	Content Address	Digital Content	Time Allocation
A	Online Banking Webpage	1. maybank2u.com.my 2. bankislam.biz	1. Account summary page 2. Account summary page	1 minute 1 minute
Gap 5 minutes				
B	Mobile Application & Social Media	1. whatsapp.com 2. ms-my.facebook.com	1. Personal room chat page 2. Home page	1 minute 1 minute
Gap 5 minutes				
C	E-News Webpages	1. beritaharian.com.my 2. nst.com.my	1. Main page 2. Main page	1 minute 1 minute

Justification: Real webpages were chosen as experiment model instead of design prototype.
Reason was to ensure data collection accuracy because the elderly have strong online presence

RESULTS AND DISCUSSION

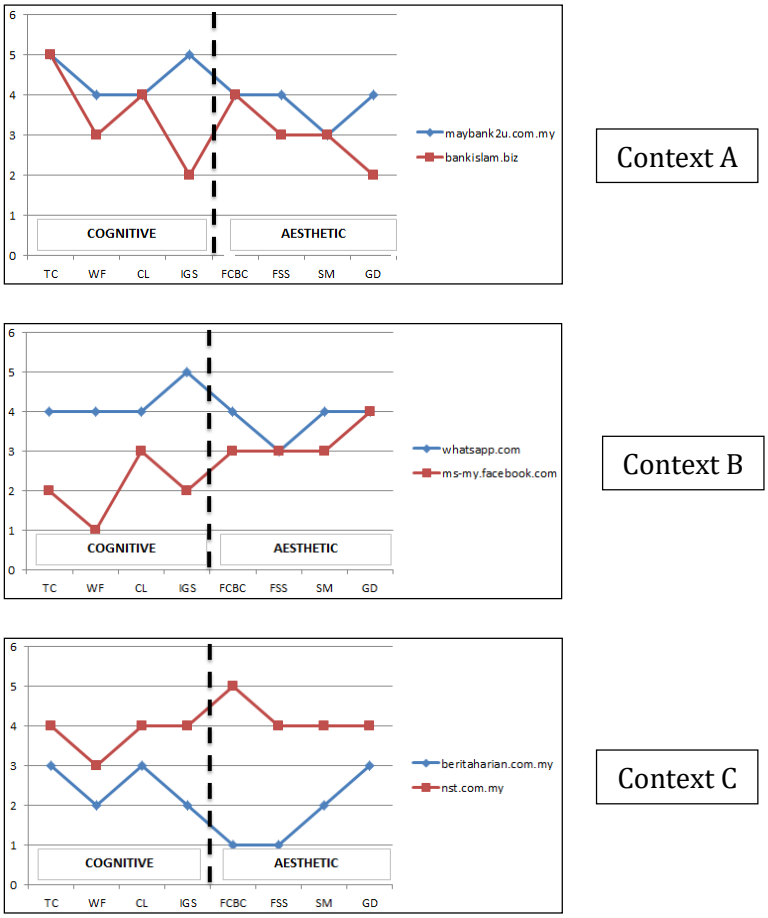

Figure 3. Summarized Score Plots for Context A, B and C.

Table 2 Summary of Participants' Preferred Dimension for Cognitive and Aesthetic Features After Participating in Digital Content Contexts

Feature Category	Cognitive Feature				Aesthetic Feature			
Feature & Code	Target Content (TC)	Window Feature (WF)	Content Layout (CL)	Info Grasp Speed (IGS)	Font Color/ Background Contrast (FCBC)	Font size/stroke (FSS)	Spacing/Margin (SM)	Graphics & Design (GD)
Description	Visible contents	No Scrollbar /popups	Clear Malay/ English language	Understand webpage aim and functions	Font color suits the background/Clearly readable	Readable type size / consistent stroke	Soothe-eye style/space/length	Clear and impactful design / good layout

Figure 3 explained the whole summarized score for Context A, B and C. Participants at their aging eye prefer all contents to be visible, no hidden contents and they neglect any event handling situations for example double clicks and mouse move for webpage to display contents. Popups are total rejected element for this group because it disturbs their emotion and attention. As participants demographic varies, they prefer contents' language that comes in Malay or English. Score showed language as less important impact to the participants. However, IGS scores showed that participantsprefered simple text display with important information concentrated mainly at the centre page. They were very attached to maybank2u.com.my and installed mobile whatsapp. These summarized for cognitive features selected for this study.

Yes, aesthetic features do play a crucial role engaging a person to remain or slide to another webpage. At their aging eyes mild visual impairment, font color, background contrast and font

size give a huge impact in satisfying the whole reading process. Font that are bolded and italiced really interrupt the reading focus. Morover, font that comes with stroke such as *Times New Roman* and *Cambria*are not the best selection for the elderly. Their preferred font size comes from 14pt to 16pt. Therefore, beritaharian.com.my did not satisfy the elderly to discover daily news updates. As for space and margins, a spacy design between characters are the elderlys' choice. Options selected for sentences are 2.0 spacing and added with space before and after paragraphs. As aesthetics explains itself, this aging group less prefer animation but instead love for static relevant graphics that is meaningful to the contents. That was why nst.com.my always been their choice to hunt for daily news updates.

This research complies with the national aspiration which is to take care of the elderly's wellbeing in many aspects. Considering the importance of usability; suitable typeface and aesthetic presentation summarized in Table 2, allows the elderly to perform electronic cognitive task load at a comfortable feeling which later increase users' satisfaction and performance.

CONCLUSION

This study reviewed most literatures that proposed best practices and guidelines addressed for the elderly who have strong online presence in them. The experiment conducted in three contexts proved that their aging eyes will satisfy their online needs if presented with suitable cognitive and aesthetic features in digital contents. Windows layout, visible contents, usage of clear and simple language and fast cognitive understanding are important elements highlighted for cognitive features. Aeshetic elements that satisfy their usability experience are font color, size, background contrast, space and margins as well as graphics presentations. These features must be considered by the digital content designers when developing online materials. Designs that fulfill usability needs willalways satisfy users' performance and users' satisfactions.

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